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"..... per litora spargite muscum,
Naiades, et circum vitreos considite fontes:
Pollice virgineo teneros hinc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Dæm pelagi, et pingui conchylia succo."
N. Parthenii Giannettasi, Eol. 1.

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I.—*A Contribution towards a Knowledge of the Entozoa of British Marine Fishes.*—Part II.* By WILLIAM NICOLL, M.A., D.Sc., Gatty Marine Laboratory, University of St. Andrews.

[Plate I.]

FOLLOWING the lines already indicated in the first part of this contribution, an attempt was made to obtain some of the less common fishes from St. Andrews Bay. At the same time several of the commoner species omitted from the first part were examined, and it is with these chiefly that the present paper deals. Altogether thirty species were examined; twelve of these were included in the first report, but several additions have to be made to the list of their parasites.

The fish to which attention was chiefly directed were the dragonet, gurnard, cod, catfish, and sprat. In each of the

* I have to thank the Government Grant Committee for enabling me to continue this work, which was begun under the Carnegie Trust Research Scheme.

first three eight different species of parasites were found, in the catfish seven, and in the sprat six. Amongst what may be considered as comparatively rare fish may be mentioned *Chimara monstrosa*, *Argentina sphyrcæna*, and *Mola mola*; and for the opportunity of examining these I am indebted to the kindness of Professor McIntosh.

About three-quarters (78 per cent.) of the total number of fish examined were infected with internal parasites of one kind or another, and of these by far the commonest were Trematodes (67 per cent.) and Nematodes (65 per cent.). Cestodes occurred only in 45 per cent., and the majority of these were scolices. Adult tapeworms were found in only 6 per cent., namely, in the cod, turbot, halibut, and sunfish. The rarity of adult tapeworms was noted in Part I., in which only 8 per cent. of the fishes were infected with them. They were found in *Cottus scorpius*, *C. bubalis*, *Gadus æglefinus*, and *Bothus maximus*. From this it would appear that tapeworms occur only in the relatively larger fish; and the reason probably resolves itself into a matter of accommodation, the intestine of the smaller fish not being of sufficient size to contain the bulk of a full-grown tapeworm. Amongst the above-mentioned fish the only ones of small size are *Cottus scorpius* and *C. bubalis*, which are infected with *Bothriocephalus punctatus* fairly frequently; but the infection never reaches the extent that is so commonly met with in the turbot. In the smaller fish scolices are very prevalent, their numbers often being counted by thousands. It is in the Elasmobranchs that Cestodes come to maturity and are so plentiful; none of these are included in the present report.

Echinorhynchus were found on only four occasions, and in every case in rock-fish, namely *Liparis montagui*, *Oncos mustelus*, *O. tricirratus*, and *Gasterosteus aculeatus*.

Over thirty new records are noted in this paper, of which half are in Trematodes. Records new to British waters are much more numerous.

In Part I. reference was made to the work of Olsson and P. J. van Beneden on the Entozoa of North-Sea fishes. Odhner's work on Arctic Trematodes* only came to hand while the paper was in the press. Although not dealing exclusively with the Trematode parasites of fishes, Odhner's paper includes descriptions of many of the most important of these, and it is to him that we owe the first exhaustive accounts of such well-known species as *Proisorhynchus squa-*

* "Die Trematoden des arktischen Gebietes," in *Fauna Arctica*, iv. (1905) pp. 291-372.

matus, *Steringophorus furciger*, *Podocotyle atomon*, *Lepidapedon* (*Lepodora*) *rachiacum*, *Lecithaster gibbosus*, and *Derogenes varicus*. Since then Miss Lebour's work* on "Fish Trematodes of the Northumberland Coast" has appeared, and this is the most comprehensive attempt which has yet been made to deal with fish from British waters. Frequent reference will be made to both these works in the following notes.

One of the most remarkable contrasts between Miss Lebour's results and those obtained at St. Andrews is evidenced in the occurrence of *Podocotyle atomon*. Special notice was made of this species in Part I. Of all the common rock-fish at St. Andrews only two, the shanny (*Blennius pholis*) and the pogge (*Agonus cataphractus*) have not been found to harbour this parasite. Ten other species of rock-fish contain it as frequently as 71 per cent. On the Northumberland coast the frequency is only 3 per cent., *Cottus scorpius* being the sole host.

I have examined all the species of rock-fish with which Miss Lebour deals except *Onos cimbrius*, and have found *Podocotyle atomon* in every one of them. I have also had occasion to examine the rock-fish in the Firth of Clyde, and there the parasite was found in 57 per cent. There also it occurred very frequently in the saithe (*Gadus virens*) and lythe (*G. pollachius*), and, in addition, in the dab and plaice. In the case of the Northumberland coast we appear to be confronted with a local peculiarity, the explanation of which is not at present obvious. A point of interest lies in the fact that the rock-fish examined by Miss Lebour were not infected, with the exception of *Cottus scorpius*, with Trematode parasites of any kind. Several other Trematodes occur in the rock-fishes at St. Andrews, e. g. *Derogenes varicus*, *Hemiurus communis*, *Stephanochasmus baccatus*, and *Prosorhynchus squamatus*. Two of these were found by Miss Lebour in *Cottus scorpius*.

No case similar to that of *Blennius pholis* † has again been met with. The only three species from which no parasites were obtained were *Merluccius merluccius*, *Chimera monstrosa*, and *Gobius minutus*; but only one or two specimens of each of these were examined.

In the following list an attempt is made to indicate with what frequency and in what numbers the various parasites occur in each host. For that purpose figures are used as

* 'Northumberland Sea Fisheries Report' for 1907 (1908), pp. 23-67.

† Part I., Ann. & Mag. Nat. Hist. (7) xix. p. 68.

follows:—I.=rarely (under 10 per cent.); II.=occasionally (10–25 per cent.); III.=commonly (25–50 per cent.); IV.=frequently (50–75 per cent.); V.=very frequently (over 75 per cent.); 1=1 or 2 at a time; 2=less than 10; 3=less than 50; 4=50–100; 5=over 100. Thus IV. 2 will be taken to indicate that a parasite occurs frequently in numbers less than ten in each host, as in the case of *Podocotyle atomon*. The fish in this part are named according to ‘A History of Scandinavian Fishes,’ by Fries, Ekström, and Sundevall.

ACANTHOPTERYGII.

<i>Trachinus vipera</i> , Cuv. Lesser Weaver.		
<i>Ascaris capsularia</i> , Rud. (juven.).	III. 1.	Body-cavity.
<i>Cottus scorpius</i> , Bloch. Bullhead.		
<i>Stephanochasmus baccatus</i> , Nicoll.	II. 1.	Intestine.
<i>Hemius communis</i> , Odhn.	II. 1.	Stomach.
<i>Cottus bubalis</i> , Euphr. Father-lasher.		
<i>Hemius communis</i> , Odhn.	II. 1.	Stomach.
(= II. appendiculatus, mihi.)		
<i>Ascaris angulata</i> , Rud.	II. 1.	Intestine.
<i>Agonus cataphractus</i> (Linn.). Pogge.		
<i>Scolex polymorphus</i> , Rud.	II. 2.	Intestine.
<i>Ascaris</i> sp.	III. 1.	Intestine.
<i>Ascaris communis</i> , Dies. (juv.).	II. 1.	Body-cavity.
<i>Callionymus lyra</i> , Linn. Dragonet.		
(Lebouria) alacris, Lss.	III. 1.	Intestine.
<i>Zoogonoides viviparus</i> (Olss.).	IV. 4.	Intestine.
<i>Derogenes varicus</i> (Müller).	III. 1.	Intestine.
<i>Lecithaster gibbosus</i> (Rud.).	II. 1.	Intestine.
<i>Scolex polymorphus</i> , Rud.	III. 3.	Intestine.
<i>Ascaris</i> sp.	III. 1.	Stomach.
<i>Heterakis foveolata</i> , Rud.	II. 1.	Intestine.
<i>Trigla gurnardus</i> , Linn. Grey Gurnard.		
<i>Stephanochasmus triglæ</i> , Lebour.	II. 1.	Intestine.
<i>Derogenes varicus</i> (Müller) (juven.).	II. 1.	Stomach.
<i>Hemius communis</i> , Odhn.	III. 1.	Stomach.
<i>Hemius lühei</i> , Odhn.	II. 1.	Stomach.
<i>Gasterostomum triglæ</i> , v. Ben.	III. 2.	Intestine.
<i>Scolex polymorphus</i> , Rud.	II. 2.	Intestine.
<i>Ascaris</i> sp.	II. 1.	Intestine.
<i>Ascaris capsularia</i> , Rud. (juven.).	III. 2.	Peritoneum.
<i>Cyclopterus lumpus</i> , Linn. Lump-sucker.		
<i>Distomum</i> sp. (juven.).	I. 1.	Rectum.
<i>Scolex polymorphus</i> .	III. 5.	Stomach, cæca, and intestine.
<i>Ascaris</i> sp.	III. 2.	Cæca and in- testine.
<i>Ascaris capsularia</i> , Rud. (juven.).	III. 2.	Liver.
<i>Liparis montagui</i> , Donov. Montague's Sucker.		
<i>Scolex polymorphus</i> , Rud.	III. 2.	Intestine.
<i>Anarrhichas lupus</i> , Linn. Catfish.		
<i>Lebouria idonea</i> , Nicoll.	IV. 4.	Intestine.
(<i>Acanthopsolus</i>) <i>anarrhichæ</i> , sp. inq.	III. 3.	Intestine.

<i>Fellodistomum fellis</i> (Ols.).	V. 4.	Gall-bladder.
<i>Fellodistomum agnotum</i> , Nicoll.	IV. 2.	Gall-bladder and duodenum.
<i>Zoogonus rubellus</i> (Ols.).	V. 4.	Rectum and intestine.
<i>Zoogonoides viviparus</i> (Ols.).	III. 3.	Rectum and intestine.
<i>Scolex polymorphus</i> , Rud.	III. 3.	Intestine.
<i>Gasterosteus aculeatus</i> (var. <i>trachurus</i>), Linn.	3-spined	Stickleback.
<i>Ascaris</i> sp.	I. 1.	Intestine.
<i>Echinorhynchus acus</i> , Rud.	I. 1.	Intestine.
<i>Gasteræa spinachia</i> (Linn.).	15-spined	Stickleback.
<i>Podocotyle atomon</i> (Rud.).	IV. 2.	Intestine.
<i>Centronotus gunnellus</i> , Linn.	Gunnel.	
<i>Hemiurus communis</i> , Odhn.	I. 1.	Intestine.
(= <i>H. appendiculatus</i> , <i>mihi</i> .)		

ANACANTHINI.

<i>Gadus callarias</i> , Linn.	Cod.	
<i>Derogenes varicus</i> (Müll.).	III. 1.	Stomach.
<i>Hemiurus communis</i> , Odhn.	III. 1.	Stomach.
<i>Gasterostomum gracilescens</i> (Rud.) (juv.).	I. 2.	Stomach.
<i>Bothriocephalus rugosus</i> , Rud.	II. 2.	Intestine.
<i>Scolex polymorphus</i> , Rud.	III. 4.	Intestine.
<i>Ascaris clavata</i> , Rud.	IV. 2.	Stomach and intestine.
<i>Ascaris capsularia</i> , Rud. (juv.).	IV. 3.	Liver and peritoneum.
<i>Ascaropsis morrhue</i> , v. Ben.	III. 3.	Œsophagus and stomach.
<i>Gadus merlangus</i> , Linn.	Whiting.	
<i>Ascaris capsularia</i> , Rud. (juv.).	II. 2.	Peritoneum.
<i>Onos tricirratu</i> s (Brün.).	Three-bearded	Rockling.
<i>Podocotyle atomon</i> (Rud.).	IV. 1.	Intestine.
<i>Ascaris</i> sp.	IV. 1.	Intestine.
<i>Ascaris capsularia</i> , Rud. (juv.).	IV. 2.	Ad cæca.
<i>Echinorhynchus acus</i> , Rud.	IV. 1.	Intestine.
<i>Onos mustelus</i> (Linn.).	Five-bearded	Rockling.
<i>Podocotyle atomon</i> (Rud.).	V. 2.	Stomach, cæca, and intestine.
<i>Echinorhynchus acus</i> , Rud.	III. 1.	Intestine.
<i>Bothus maximus</i> (Linn.).	Turbot.	
<i>Ascaris collaris</i> , Rud.	III. 1.	Stomach and intestine.
<i>Pleuronectes flesus</i> , Linn.	Flounder.	
<i>Ascaris collaris</i> , Rud. (juven.).	III. 1.	Intestine.
<i>Pleuronectes limanda</i> , Linn.	Dab.	
<i>Lecithaster gibbosus</i> (Rud.).	I. 1.	Intestine.
(= <i>Derogenes cacozelus</i> , <i>mihi</i> .)		
<i>Ascaris capsularia</i> , Rud. (juven.).	II. 2.	Body-cavity.
<i>Hippoglossus vulgaris</i> , Flem.	Halibut.	
<i>Lecithaster gibbosus</i> , Rud.	II. 1.	Intestine and rectum.
(= <i>Derogenes cacozelus</i> , <i>mihi</i> .)		
<i>Hemiurus communis</i> , Odhn.	III. 1.	Stomach.
(= <i>H. appendiculatus</i> , <i>mihi</i> .)		
<i>Bothriocephalus punctatus</i> , Rud.	II. 2.	Stomach, cæca, and intestine.

PHYSOSTOMI.

<i>Osmerus epulanus</i> .		
Lecithaster gibbosus, <i>Rud.</i>	II. 1.	Intestine.
Scolex polymorphus, <i>Rud.</i>	II. 3.	Intestine.
Ascaris sp. (juven.).	II. 1.	Intestine.
<i>Argentina sphyraena</i> , Linn. Argentine.		
Lecithophyllum botryophoron (<i>Ols.</i>).	IV. 3.	Intestine.
<i>Clupea sprattus</i> , Linn. Sprat.		
Derogenes varicus (<i>Müll.</i>) (juven.).	I. 1.	Cæca.
Lecithaster gibbosus (<i>Rud.</i>).	I. 1.	Intestine.
Hemius lühei, <i>Odhn.</i>	II. 1.	Œsophagus, stomach, cæca, and intestine.
Scolex polymorphus, <i>Rud.</i>	I. 1.	Intestine.
Ascaris sp.	II. 2.	Stomach and intestine.
Ascaris sp. (juven.).	II. 2.	Peritoneum.
<i>Anguilla vulgaris</i> , Turt. Eel.		
Hemius communis, <i>Odhn.</i>	III. 1.	Stomach.
(= <i>H. appendiculatus</i> , <i>mih.</i>)		

PLECTOGNATHI.

<i>Mola mola</i> (Schneider). Sunfish.	
Dihemistephanus lydiæ (<i>Stoss.</i>).	Intestine.
Ancistrocephalus microcephalus (<i>Rud.</i>).	Intestine.
Anthocephalus reptans, <i>Wagener.</i>	Liver.

LOPHOBRANCHII.

<i>Syngnathus acus</i> , Linn. Pipefish.	
Scolex polymorphus, <i>Rud.</i>	IV. 2. Intestine.
Ascaris sp. (juven.).	IV. 1. Peritoneum.

Podocotyle atomon (Rud.).

Odhner, Fauna Arctica, iv. (2) p. 320.
 Nicoll, Ann. & Mag. Nat. Hist. (7) xix. pp. 73-77.
 Lebour, Northumberland Sea Fish. Rept. 1907, pp. 36-37.
 Nicoll, Quart. J. Micr. Sci. liii. pt. 3, pp. 451-453.

To the list of British hosts of this parasite has to be added *Gastræa spinachia*. In one specimen of this fish half a dozen examples of the parasite were found. They agreed well with previous descriptions of the species, but the ova were particularly large, measuring .085-.093 mm. in length and .051-.062 in breadth. These are by far the largest ova I have yet observed in this species, and I was at first in doubt whether the specimens were really *Podocotyle atomon* or some allied species. No other differences of importance could be made out. The length of the specimens is 1.7-2.3 mm.; oral sucker .14-.16 mm. in diameter; ventral sucker .20×

·25 mm.; breadth $\frac{1}{4}$ of the length; neck also $\frac{1}{4}$ of the length, and the posterior border of the second testis about the same distance from the posterior end of the body. Pharynx ·09 mm.; œsophagus ·105 mm.; excretory vesicle extending forward to anterior end of ovary. Ovary close in front of testes, trilobate. Receptaculum seminis immediately in front of ovary. Testes directly tandem or very slightly oblique, round, isodiametric; diameter ·20 mm.; separated by yolk-glands. Yolk-glands extending forward to posterior border of ventral sucker; not discontinuous at testes. Vesicula seminalis extending ·1–17 mm. behind ventral sucker, *i. e.* about $\frac{1}{3}$ of length of body, or rather more than half the diameter of the ventral sucker.

From the above notes there can be little doubt that the specimens under consideration are actually *Podocotyle atomon*. A fact which might cause hesitation in admitting this identification is that Odhner has frequently found a closely allied species, *P. reflexa* (Crepl.) in *Gastrea spinachia* (*Spinachia vulgaris*). According to Odhner, this species differs from *P. atomon* in being much more elongated, less flattened, and in having the suckers more nearly approximated. Other features noted by Odhner are the great prominence of the ventral suckers, the length of the œsophagus relative to the pharynx, the greater breadth of the testes, the greater length of the cirrus-pouch, the median position of the ovary, and the discontinuous condition of the yolk-glands. The majority of these characters, however, are of little value when dealing with such a species as *Podocotyle atomon*. It does not require a very extensive study to convince one that *Podocotyle atomon* is within certain limits a very variable species, and it is just in the above-detailed features that the variation occurs. No weight can be placed on the length of the œsophagus, for in *Podocotyle atomon* it may be shorter than the pharynx, or, as Miss Lebour notes, more than double its length, depending almost entirely on the state of contraction of the body. Again, the testes not infrequently exceed half the breadth of the body, and the ovary may be only very slightly, if at all, displaced from the middle line. The yolk-glands are extremely variable and may be entirely absent between the testes or may fill up a considerable part of the intertesticular space; further, they are fairly often discontinuous laterally at the level of the intertesticular space or the posterior testis. The cirrus-pouch may extend barely beyond the ventral sucker, or it may occasionally reach nearly halfway to the ovary. The extended condition of the body and the prominent pedunculated appearance of

the ventral suckers depend largely on the method of killing. Fresh water, for instance, causes the body to be much elongated and the ventral sucker to be raised on a well-marked pedicle. It also alters other relations, so that the neck becomes much shorter and the breadth of the body is decreased, while the thickness is greatly increased. In such a condition the parasite agrees much more closely with Odhner's description of *Podocotyle reflexa* than with his description of *P. atomon*. From this it appears that undue importance must not be attached to the elongated cylindrical shape, with projecting ventral sucker, as in *P. reflexa*, unless when dealing with specimens collected and preserved in a uniform manner. Under these conditions it may be safe to differentiate, as Odhner has done, species such as *P. reflexa* and *P. olssoni*, but at the same time it is probable that Odhner's definitions are too comprehensive. Certain features which he mentions are of undoubted specific value, and of these I should put most reliance on the breadth of the body, the length of the neck, and the length of the cirrus-pouch. In none of my specimens, it may be noted, is the breadth less than $\frac{1}{4}$ or the neck less than $\frac{1}{6}$ of the body-length.

Admitting the specific identity of *Podocotyle reflexa*, it is quite evident that my specimens from *Gastraea spinachia* are not identical with Odhner's specimens from the same host, for they are flattened; the neck is much longer and the breadth is greater than in that species. In addition the testes do not occupy more than half the breadth of the body, the cirrus-pouch extends only a short distance behind the ventral sucker, the ovary is on the right side, and the yolk-glands are in no case discontinuous at the level of the testes. In fact the specimens are absolutely typical examples of *Podocotyle atomon* apart from the large size of the ova.

An immature example of the same parasite was obtained from the intestine of *Onos tricirratus*, this making the twelfth British host of the species, all of these being rock-pool fish with the exception of the plaice, as recorded by Miss Lebour, and the flounder, as recorded by Johnstone. Three additional hosts which I have to record from the West Coast bring the total up to fifteen.

(*Lebouria*) *alacris*, Lss. (Pl. I. fig. 1.)

From *Callionymus lyra* a single specimen of a species which can only with very great doubt be identified with *Distomum alacre*, Lss. *, was obtained. It was 1.4 mm.

* Centralbl. f. Bakt. xxix. p. 401.

long; greatest breadth half the length. Oral sucker $\cdot 21$ mm. in diameter; ventral sucker $\cdot 32 \times \cdot 34$ mm., situated $\cdot 55$ mm. from the anterior end. Pharynx $\cdot 14 \times \cdot 11$ mm., prepharynx and œsophagus short. Ovary oval, immediately behind the ventral sucker on the right side, smaller than the testes. Testes immediately behind ovary, tandem. Yolk-glands not very voluminous, lateral, extending into neck as far as intestinal bifurcation; almost absent at level of ventral sucker; uniting behind testes. Genital aperture median, not far in front of ventral sucker. Cirrus-pouch short, not extending beyond the centre of the ventral sucker, containing a simple vesicula seminalis, a short ductus ejaculatorius, and apparently a definite pars prostatica. Ova $\cdot 082\text{--}\cdot 086 \times \cdot 040\text{--}\cdot 042$ mm.; blunt at both poles. Simple excretory vesicle extending forward to anterior testis.

Mr. Johnstone, of Liverpool, has allowed me to examine a small immature specimen of what appears to be the same species from *Callionymus lyra*, obtained in Luce Bay. I have also collected a considerable number of specimens from *Callionymus* in the Firth of Clyde. These appear to be the same species; a description of them will be published later.

This specimen agrees with Looss's description of *Distomum alacre* in several important particulars. The disposition of the genital organs is the same in both, although the yolk-glands are not so extensive in my specimen. They agree also in the size and situation of the ventral sucker. The most important differences are that my specimen is much broader, while the oral sucker and pharynx are much larger. In these respects it approaches nearer *Lebouria idonea*, mihi*.

Looss seemed to hesitate in including *Distomum alacre* amongst the Allocreadiinæ, but there seems little doubt that it is really a member of this subfamily. It is most nearly related to the genus *Lebouria*, and it is only the somewhat anomalous structure of the cirrus-pouch which prevents its definite inclusion in that genus.

In the specimens from the West Coast the average length is $1\cdot 1$ mm., the breadth is $\frac{2}{3}$ of that, and the ventral sucker is situated exactly $\frac{2}{3}$ of the length from the anterior end. The diameter of the oral sucker is constantly $\frac{1}{4}$ of the body-length, while that of the ventral sucker is a trifle more than $\frac{1}{4}$. The ventral sucker is oval and its shorter diameter is not quite $\frac{1}{2}$ of the body-length. The pharynx is exactly $\frac{1}{2}$ of the body-length. In practically every one of these features

* Quart. J. Micr. Sci. liii. pt. 3, pp. 441-451, pl. ix. figs. 9-12.

the West-Coast specimens agree with my first specimen and differ correspondingly from Looss's description of *Distomum alacre*. They agree with the latter more closely in having the yolk-glands extending forward to the pharynx and the genital aperture slightly displaced from the middle line towards the left.

Stephanochasmus baccatus, Nicoll.

One specimen of a *Stephanochasmus* species was found in the intestine of *Cottus scorpius*, and although it does not entirely agree with my previous description of *St. baccatus**, it is the only species to which it can be referred. The most important point serving for identification is the fact that it possesses 28 cephalic spines in each row. Those of the anterior row are shorter than those of the posterior row, but their length is somewhat variable. The cuticular spines seem to be absent from a great part of the dorsal surface of the body.

The length of the specimen is 2·4 mm.; greatest breadth ·7 mm. The neck is 1 mm. long, which is considerably greater than in the first specimen, but may be accounted for by assuming a greater degree of extension. The diameter of the oral sucker is ·18 mm., of the ventral sucker ·31 mm. The prepharynx is ·22 mm. and the pharynx measures ·20 × ·19 mm. All these figures agree well enough with those already given. The testes are contiguous and have each a diameter of about ·3 mm. The second testis is about $\frac{1}{3}$ of the body-length from the posterior end of the body. The ovary is ·17 mm. in diameter, lying immediately in front of the anterior testis and ·4 mm. behind the ventral sucker. It is thus much nearer the sucker than in the previous example. The yolk-glands are slightly more extensive than before, but do not reach the level of the ventral sucker. The cirrus-pouch is comparatively short and does not extend beyond the ventral sucker to a greater distance than the diameter of the sucker (*i. e.* not more than $\frac{1}{10}$ of the body-length). The ova are larger than before, measuring ·101 × ·046 mm.

The specimens both from *Hippoglossus* and from *Cottus* were found in gut which had been preserved in formalin and not examined for parasites till some time afterwards. There was thus no opportunity of getting them in a properly extended condition, and this probably explains the somewhat different appearance which they present.

* Ann. & Mag. Nat. Hist. (7) xix. pp. 80-83, pl. ii. figs. 5-7.

Stephanochasmus triglae, Lebour*.

From the intestine of *Trigla gurnardus* † a single specimen of what can hardly fail to be this species was obtained. The species is exceedingly like *St. baccatus*, and, as far as can be made out, practically the only difference to which any importance can be attached is in the number of cephalic spines. Miss Lebour did not determine this number, but in the specimen under consideration it appears to be 50, *i. e.* 25 in each row. This difference of six spines may or may not be a feature of specific distinction; if not, the two species must be considered identical. After a careful examination of Miss Lebour's description and my own specimens the only other feature of difference to be found is in the extent of the yolk-glands, which reach the ventral sucker in *St. triglae* but stop short of it in *St. baccatus*. This, however, is a rather hazardous distinction.

The cephalic spines surround the oral sucker in two uninterrupted rows, and they measure .03 mm. in the anterior row and .035 mm. in the posterior row. In my specimen the spines in the posterior row, instead of being directed straight backwards, diverge slightly from the middle line, but this condition is probably accidental. The spines over the rest of the body appear to be more numerous and thickly set than in *St. baccatus*, and their distribution is possibly more extensive.

The length of the specimen is 2.9 mm., of which the neck comprises 1 mm.; the breadth is .6 mm. Diameter of oral and ventral suckers .20 mm. and .27 mm. respectively; prepharynx .32 mm. long; pharynx .17 × .15 mm.; œsophagus almost absent. Testes elongated oval, measuring .36 × .24 mm., not quite contiguous, separated by yolk-glands. Ovary .17 mm. in diameter, separated from testes by yolk-glands. Latter extend as far forwards as the posterior border of the ventral sucker. Cirrus-pouch not extending beyond the ventral sucker to a greater distance than the diameter of the sucker, as in *St. baccatus*. The specimen contained no ova.

Dihemistephanus lydie (Stossich).

(Pl. I. figs. 2, 3.)

Stossich, Boll. Soc. Adriat. xvii. (1896) p. 4, pl. i. fig. 1.

Looss, Centralbl. f. Bakt. xxix. (1901) pp. 605-606 & 628, fig. 6.

In the intestine of a sunfish (*Mola mola*), captured in the

* Northumberland Sea Fisheries Rep. 1907 (1908), pp. 47-48, pl. iii. figs. 3-4.

† In a recent note (Ann. & Mag. Nat. Hist. (8) iii. p. 246) this specimen was inadvertently referred to *Cottus scorpius*.

Firth of Forth and forwarded to Professor M'Intosh, a large number of specimens of this parasite were found. Stossich's original description of the species is incomplete and contains several errors, which were corrected by Looss's amended description. My specimens differ in a few particulars from those examined by Looss, and both on that account and on account of the comparative rarity of the species I shall give here a fairly full description of it.

My specimens are only half the size of Stossich's, measuring for the most part from 1.8 mm. to 2.4 mm. They are extended and flattened, but the neck is somewhat subcylindrical. The greatest breadth is a little more than $\frac{1}{4}$ of the length and occurs, as a rule, about the level of the ventral sucker, but in many cases it is as far back as the anterior testis. From this point the body narrows rapidly towards the anterior end, but behind the sucker it preserves a fairly uniform breadth, till near the posterior end, where it comes abruptly to a point; in some cases the posterior end is bluntly rounded. Almost the entire surface is covered with spines, which show much greater variations in size than is usual amongst spinous Trematodes. Over the greater part of the body they are long, curved, and sharp, with a fairly broad base, and, as usual, they are largest and strongest just in front of the ventral sucker. Forwards these large spines stop suddenly a little in front of the pharynx, and their place is taken by very much smaller spines of minute size. The large spines advance further forwards in the middle line and at the extreme edges of the body than elsewhere, so that the minute spines appear to be congregated in two lateral patches, united, however, in the middle line in front. Precisely the same arrangement occurs on the dorsal surface, although in this case the large spines are found a little further forward than on the ventral surface. In the latter point this differs from Looss's description. In the arrangement of the cephalic spines another difference must be noted. In addition to the two series described by Looss, a third one occurs in many, though not in all, of my specimens (Pl. I. fig. 3). This is situated on the dorsal surface a short distance behind the hind rows of large spines, and consists of a row of about 10 straight sharp spines, resembling the large spines, but only about half their size (length .025 mm.). It is hardly necessary to be reminded here that cephalic spines are only too prone to be knocked off and disappear without leaving traces of their existence. In the majority of my specimens the cephalic armature was incomplete. Such must have been the case in Looss's specimens, otherwise this third series of spines could not have

escaped notice, for they are prominent and distinct enough in the specimens in which they are present. The same applies to the ventral series of very small spines, which Looss describes as consisting of two rows of 5 and 6 in each. In some of my specimens these are entirely absent, and in the others they vary in number from 3 up to 15. In the specimen in which the maximum number was present there were 6 spines in the anterior row and 7 in the posterior row, and at each end of the series there was a single spine of the same size occupying a position neither in one row nor the other, but midway between the two. From this it is evident that it is a difficult matter to determine the exact number of the ventral series, and there may even be a doubt if it consists normally of a definite number. The arrangement of the largest spines is exactly as Looss has described, the spines being all of approximately equal length ($\cdot 04$ – $\cdot 05$ mm.) except the two terminal spines of the anterior row, which are a little shorter than the others. I find the number to be 18 in the anterior row and 17 in the posterior, but it is not easy to determine this exactly.

The oral sucker is terminal and measures $\cdot 19$ – $\cdot 22$ mm. in diameter, *i. e.* about $\frac{1}{10}$ of the body-length. It has a slight tendency towards a funnel-shape, but the margin is not necessarily rampart-like (*wallartig*) as Looss describes it. In almost all my specimens the ventral lip is thin and sharp, while the dorsal lip is thickened for the insertion of the large cephalic spines. Along with the spines this thickening extends round to the sides, and this gives the head a somewhat square shape in some specimens. The ventral sucker is situated at a distance from the anterior end varying with the degree of extension of the neck, but on an average it is about 1 mm.; in other words, the sucker lies a little in front of the middle of the body. It is a feeble, shallow, evidently degenerate structure. In most cases it lies level with the body-surface, but in some its edges are raised a little. It is always distinctly larger than the oral sucker, its diameter being $\cdot 22$ – $\cdot 27$ mm., and the sucker-ratio being approximately 6:7.

The prepharynx is about $\cdot 1$ mm. in length, but may be twice as long or entirely absent, according to the state of contraction. The pharynx has an average measurement of $\cdot 145 \times \cdot 10$ mm. The œsophagus is normally a trifle shorter than the pharynx. The diverticula are thin-walled and wide, extending quite to the posterior end of the body.

The ovary and testes are situated in the posterior half of the body, the post-testicular space being a little more than $\frac{1}{2}$

of the body-length. The testes are tandem, transversely ovoid, and measure about $\cdot 21 \times \cdot 26$ mm. In every case they are contiguous. The ovary lies immediately in front of the anterior testis, but displaced a little to the right side. It is also transversely ovoid, but is considerably smaller than the testes, measuring $\cdot 17 \times \cdot 12$ mm. There does not appear to be a receptaculum seminis. The yolk-glands are exceedingly well developed and very conspicuous. Neither Stossich nor Looss describes their disposition accurately. They are situated for the most part under the dorsal surface of the body, but a ventral fringe of uniform breadth extends from the posterior end of the body to a point a short distance in front of the ventral sucker. This fringe lies over the outer side of the intestinal diverticula, and nowhere throughout its whole extent crosses to the inner side of the diverticula. Dorsally the follicles are much more extensive. They fill the whole of the post-testicular space. Forwards they extend in towards the middle line and overlap the testes and ovary to a considerable extent. They thin out a little at the level of the uterus, but in front of the ventral sucker they again become voluminous and extend across the entire breadth of the body. Their anterior limit is the same as in the case of the ventral fringe. The common yolk-ducts are ventral and cross between the ovary and anterior testis, to unite in the yolk-reservoir.

The genital aperture lies close to the anterior border of the ventral sucker. It is not median in position, but is displaced a little to the left side. The genital sinus is of small size. The ductus ejaculatorius opens into it on the right side, the vagina on the left. The cirrus-pouch lies dorsal to the ventral sucker and invariably terminates at the posterior border of the latter. The anterior narrow part of the pouch is always bent more or less abruptly on the more swollen posterior part. The latter contains a single simple globular or ovoid vesicula seminalis, in close connexion with which is a comparatively large pars prostatica, also nearly globular in shape. Prostatic cells do not appear to be numerous, although the pars prostatica is filled with a large amount of secretion. The ductus ejaculatorius is short and fairly straight. The uterus occupies the space between the anterior testis and the genital aperture, confined by the intestinal diverticula on either side. Unlike the uterus in the genera *Echinostomum* and *Stephanochasmus*, it frequently forms several convolutions dorsal to the ventral sucker, so that Looss is not quite exact in saying that it is confined between the ovary and ventral sucker. The vagina is short and

muscular. The ova are thin-shelled, with blunt poles, the opercular pole being obliquely truncated. My measurements of the ova do not agree with those of Looss, for from a large number I find the average size to be $.066 \times .0365$ mm., the observed limits being $.060$ – $.072$ mm. for the length and $.032$ – $.040$ mm. for the breadth. Looss gives the breadth as $.047$ mm.

The genus *Dihemistephanus* is, as Looss remarks, most closely allied to *Stephanochasmus*. The shortness of the copulatory organs and the close proximity of the genital glands are not so weighty differences as Looss suspected, for since then two species of *Stephanochasmus* (*St. trigle*, Lebour, and *St. baccatus*, mihi) have been described which approach the condition in *Dihemistephanus lydie*. Of apparently greater importance are, apart from the cephalic armature, the shape and size of the pars prostatica and the extent and disposition of the yolk-glands. Together the two genera form a group which differs from the true Echinostominae in the possession of a terminal oral sucker with cephalic spines directly attached to its margin, the absence of a cephalic collar, and the possession of a large pharynx, which is situated nearer to the intestinal bifurcation than to the mouth.

(*Acanthopsolus*) *anarrhichæ*, sp. inq.

Under this provisional name I wish merely to mention a species which occurs in the intestine of *Anarrhichas lupus*. It has already been found and briefly described by Miss Lebour*. It is evidently a new species and almost undoubtedly the type of a new genus, but several important points in its anatomy require yet to be determined. I am not in a position to add anything to Miss Lebour's description, as my material consists of only a few immature specimens which were accidentally discovered amongst a collection of *Zoogonus rubellus* from the same host. Probably many specimens were overlooked in collecting, for the species is about the same size as, and bears much external resemblance to, *Zoogonus rubellus* and *Zoogonoides viviparus*, both of which were found together in large numbers in the intestine of the catfish.

With regard to the systematic position of this species, it approaches most closely, as Miss Lebour remarked, to *Acanthopsolus oculatus* (Levins.), but it possesses one or two features sufficient to exclude it from the genus *Acanthopsolus*.

* Northumberland Sea Fisheries Rep. 1907 (1908), pp. 51–53, pl. iii. figs. 6 & 8.

Together they form the nucleus of a subfamily the nearest relation of which appears to be not *Stephanochasmus*, as Odhner remarked in the case of *Acanthopsolus oculatus*, but the Lepocreadiinae. It is impossible to include them in the latter subfamily, but they are certainly nearly allied to it.

Steringophorus furciger (Olsson).

The occurrence of this species in *Lophius piscatorius*, as recorded by Miss Lebour, is probably fortuitous, the parasites being in all likelihood from some Pleuronectid fish swallowed by the Angler. In British waters the species appears to be entirely confined to the Pleuronectidæ and to be one of their most characteristic parasites.

Zoogonoides viviparus (Olsson).

In British waters this species has hitherto only been found in Pleuronectid fishes, in which it occurs in great abundance. I have found it quite as frequently and in as large numbers in *Callionymus lyra* and *Anarrhichas lupus*. In the North Sea I have also found it fairly frequently in *Pleuronectes cynoglossus* and *Drepanopsetta platessoides*, and in the Firth of Clyde in *Pl. flesus* and *Pl. microcephalus*. This makes a total of nine British hosts for the species.

The species is already so well known that no additional description is necessary. It seems necessary to insist, however, that the diameter of the ventral sucker is not twice that of the oral sucker, as both Odhner and Miss Lebour have it. In my specimens the ratio is almost constantly 3:2, the average sizes being .22 mm. and .145 mm. in a specimen of .9 mm. length.

With regard to the coloration, considerable variation seems to occur. The general body-colour is lemon-yellow, with numerous irregular splashes of brownish red, which is so intense that when a number of parasites are viewed together they appear to be of a dusky red colour. To me the parasite has never appeared of a bright red colour, as Miss Lebour describes it. Many specimens, however, seem to lack these red patches, and the doubt has often occurred as to whether the uniformly coloured specimens were really the same as the others; but no structural differences could be detected.

Van Beneden's *Distomum callionymi** is very probably *Zoogonoides viviparus*. The figures which he gives show some of the characteristic attitudes of that species, but otherwise they are unrecognizable.

* Mém. Acad. Roy. Belg. xxxviii. p. 53, pl. iv. fig. 3.

Zoogonus rubellus (Olsson). (Pl. I. fig. 4.)

Distoma rubellum, sp. n., Olsson, Lunds Univ. Årsskrift, iv. (8) p. 41, pl. iv. fig. 89.

Zoogonus mirus, sp. n., Looss, Centralbl. f. Bakt. xxix. pp. 439-442, fig. 6.

Zoogonus rubellus (Olsson), Odhner, Centralbl. f. Bakt. xxxi. pp. 59-61, fig. 1.

Zoogonus mirus, Lss., Goldschmidt, Centralbl. f. Bakt. xxxii. pp. 870-876, figs. 1-6.

This species has been hitherto recorded only from Labridæ, but I have found numerous examples in every specimen of *Anarrhichas lupus* in the rectum and lower part of the intestine. Three excellent descriptions already exist, but some doubt still remains as to whether *Z. rubellus* and *Z. mirus* are identical or not. A few differences of a minor nature occur in the accounts of the above-cited authors; my specimens agree best with Goldschmidt's description.

They are pale yellow in colour and of small size, measuring for the most part .75-1.0 mm. Externally they resemble *Zoogonoides viviparus* very much, but they are not so delicate as that species. The shape is elongated oval, the greatest breadth, about the level of the ventral sucker, being rather less than half the length. The whole surface of the body is covered with minute regular scale-like spines. The oral sucker is subterminal and globular, with a diameter of .115-.135 mm. The ventral sucker is flattened and usually isodiametric, measuring .135-.165 mm. In a number of specimens it is contracted and distorted as in Looss's figure. It thus appears smaller than the oral sucker and this may account for Looss's observation. It is situated exactly $\frac{2}{3}$ of the body-length from the anterior end. The configuration of the alimentary system conforms much more with Goldschmidt's representation than with that of Looss or Odhner. The prepharynx is not usually dilated and is rather shorter than the pharynx. The latter is oval and measures .10-.13 x .08-.09 mm. The œsophagus is comparatively of great length and extends right behind the ventral sucker before the bifurcation takes place. As a matter of fact, it is difficult to say where the bifurcation actually occurs, for dorsal to the ventral sucker the œsophagus expands considerably, and the diverticula arise from this expansion as two wide sacs. The exact point of bifurcation is thus not marked off with such distinctness as in most other species. The internal walls of the diverticula can always be seen uniting just behind the posterior border of the ventral

sucker, as in Goldschmidt's figure and my own. Both Looss and Odhner represent the diverticula as elongated sacs arising from a point in front of the ventral sucker; but in reality they are short, oval, club-like structures, the appearance of which is almost unique. Olsson's figure gives an indication of this.

The testes are two large globular bodies situated one on each side of the ventral sucker at the level of its posterior border. The ovary is situated further back near the ends of the intestinal diverticula, median in position and of globular or ovoid shape. The minute yolk-gland lies just in front of the ovary and the fairly large receptaculum seminis lies a little behind and to the right of the ovary. The genital aperture is situated at the left margin of the body on the level of the aperture of the ventral sucker. The cirrus-pouch is moderately large, retort-shaped, and extends barely beyond the posterior border of the ventral sucker. Its posterior part lies dorsal to the outer portion of the sucker, not, as Odhner and Goldschmidt represent it, entirely to the left side of the sucker, except in compressed specimens. It contains a bipartite vesicula seminalis, of which the posterior part is considerably the larger, a small but distinct pars prostatica, and a short ductus ejaculatorius, not lined by spines. The uterus is confined mainly to the space behind the ends of the intestinal diverticula and contains *Miracidia* in all stages of development. A full description of these is given by Looss and Goldschmidt.

Looss's *Zoogonus mirus* is in all probability identical with Odhner's *Z. rubellus*—at any rate, features sufficient to distinguish them are not at present apparent.

Derogenes varicus (Müller).

To the list of hosts in which I have already found this species must be added *Callionymus lyra* (frequently in the intestine), *Trigla gurnardus* (an immature specimen in the stomach), *Gadus callarias* (occasionally in the stomach), and *Clupea sprattus* (an immature specimen in the cæca). This brings the number of British hosts of this species up to 15 and it is still to be found in many others. Although evidently very widely distributed it very probably occurs most frequently in Pleuronectidæ and Gadidæ.

Lecithoster gibbosus (Rud.). (Pl. I. fig. 5.)

= *Derogenes cacozelus*, mihi, Ann. & Mag. Nat. Hist. (7) xix. pp. 90-91, pl. iii. fig. 10.

This was erroneously described as a new species from

Hippoglossus vulgaris and *Pleuronectes limanda* in Part I.* It was also met with in *Ammodytes tobianus*. To these have to be added *Callionymus lyra*, *Osmerus eperlanus*, and *Clupea sprattus*. With the whiting and grey gurnard, recorded by Miss Lebour, and *Belone vulgaris* by Johnstone†, there is now a total of nine British hosts for the species, but to that number I shall have shortly another five to add. It is thus a widely distributed species and does not appear to have a special affinity for any particular group of fishes. The most remarkable feature about this parasite is that, according to my experience, very rarely does more than one specimen occur in any host at one time. This does not accord with Miss Lebour's experience, but I have been struck with the curious circumstance on numerous occasions. Practically the only host in which I ever obtained more than a couple of specimens was the whiting in the Firth of Clyde. This is one of the hosts in which Miss Lebour found the parasite, so that it may be specially liable to infection.

Contrary to Miss Lebour, I find that the species has a distinctly red colour, which renders it easy to be picked out from the intestinal contents. The characters of the species are sufficiently well known to obviate the necessity for redescription. One feature, however, must be mentioned, which has apparently escaped notice by previous observers, and that is the peculiar character of the contents of the excretory vesicle. Though not aware of it at the time, I first remarked on this in the case of my specimen from *Ammodytes tobianus*. Two concentrically ringed bodies are there referred to, but as the specimen was unfortunately destroyed no further investigation of their nature was possible. Since then I have seen similar bodies several times in living specimens of *Lecithaster gibbosus* and usually in much greater numbers. They occur in all sizes from tiny specks to globules half as large as the testes, and the larger ones almost invariably appear as if they contained smaller concentrically arranged globules within them. For this appearance there seems no obvious explanation, but there can be little doubt that the bodies are really globules of excretory matter. At any rate, they are contained within the main excretory vessels and are evidently homologous with the much smaller and more uniform globules commonly met with in the excretory vesicle of many other Trematodes. They were certainly not present in every specimen, and they always disappear on

* For drawing my attention to the identity of this species I am indebted to Dr. Odhner, of Upsala.

† Trans. Biol. Soc. Liverpool, xxi. (1907) pp. 185-6, fig. 16 (*Distonum molissimum*).

preservation, which may account for the fact that no previous mention has been made of them. In the living animal, however, they present one of the most striking features.

The average length of my specimens collected at St. Andrews is 1.4 mm. The ventral sucker is situated at a distance of about $\frac{3}{8}$ of the body-length from the anterior end. The diameter of the oral sucker is $\frac{1}{11}$ of the body-length and that of the ventral sucker rather more than $\frac{1}{8}$. The sucker-ratio is therefore approximately 2 : 3. Miss Lebour makes it 1 : 2, but in her drawing it is almost exactly 2 : 3. The diameter of the pharynx is usually $\frac{1}{20}$ of the body-length. The average size of the ova is $.021 \times .0145$ mm.

Hemiurus communis, Odhner.

In addition to the hosts already recorded for this species must be mentioned *Trigla gurnardus*, *Cottus scorpius*, and *Gadus callarias*. It was also erroneously recorded in Part I. as *Hemiurus appendiculatus* (Rud.) from *Cottus bubalis*, *Centronotus guernellus*, *Hippoglossus vulgaris*, and *Anguilla vulgaris*. This makes the number of British hosts twelve*, but there are at least another nine fishes in which I have found it. It thus rivals *Derogenes varicus* as the most widely distributed Trematode parasite of marine fishes. This is probably due to the fact that the larval stage of both is passed in some very common Crustaceans, most likely Copepods. Levinsen's discovery of the larva of *Derogenes varicus* in the Polychæt worm, *Harmothoe imbricata*, has never been confirmed, so that much doubt must remain as to the correctness of his observation. Pratt's discovery of true Hemiurid larvæ in Copepods indicates that they are really the hosts in which to look for the early stages of *Hemiurus* forms.

A word may not be out of place here in reference to the recent proposal by Looss† to apply the terms *soma* and *abdomen* respectively to the body and appendicular part of appendiculate Distomes. The word abdomen has, apart from its classical meaning, a recognized and definite significance in the anatomical terminology not only of Vertebrata but also of Invertebrata, and it seems unreasonable to apply such a general and well-known term to a single, small, specialised part. Such a use of the term has no justification on anatomical grounds, for in only a certain proportion of cases does

* It is recorded by Johnstone as *Distomum appendiculatum* from the plaice, dab, and whiting.

† Zool. Anzeig. xxxi. (1907) p. 585.

even a small part of the viscera extend into the appendicular part, the true function of which remains unelucidated. The older term "appendix" is much more applicable; but if exception is taken to that it is not difficult to coin a word, e. g. *ecsoma* (the part out of the body), much more appropriate than *abdomen*. The term *introvert* seems quite as suitable as any, even although it is used to describe different special organs in various groups of animals.

Recent work may be considered to have fairly well established the specific characters of *Hemiurus communis*, but there are still one or two points on which absolute uniformity does not exist. The length of the soma is 1-3 mm. The average breadth is about $\frac{1}{4}$ of the length of the soma, greatest just before the junction with the ecsoma. The latter is at most $\frac{2}{3}$, frequently less, of the length of the soma. The neck (distance of the ventral sucker from the anterior end) is about $\frac{1}{3}$ of the length of the soma. These measurements have been agreed on by every observer, but in connection with the sizes of the suckers my results are at variance with those of others. Both Oehlner and Miss Lebour* give the ratio as approximately 1 : 2, but I have never yet found a specimen in which the ventral sucker was twice as great as the oral sucker. I find the ratio always greater than 1 : 2 and often as much as 2 : 3. There is therefore no difference in this respect between *Hemiurus communis* and *H. lüheii*. Wherein the difference between the two species really consists is that in *H. lüheii* the suckers are proportionately much smaller than in *H. communis*. In the latter the diameter of the ventral sucker is about $\frac{1}{4}$ of the length of the soma, but it may be as small as $\frac{1}{5}$ or as large as $\frac{1}{3}$, depending to a great extent on the state of contraction. In *H. lüheii* the ventral sucker rarely exceeds $\frac{1}{11}$ of the length of the soma. In *H. communis* the oesophagus is nearly equal to the pharynx in length. The genital sinus does not extend backwards as far as the ventral sucker; the pars prostatica is of moderate length. The vesicula seminalis is bipartite, thin-walled, and situated just behind the ventral sucker. The testes are placed immediately behind the vesicula seminalis, always more or less obliquely behind each other. The ovary is separated from the testes by $\frac{1}{4}$ of the length of the soma.

Hemiurus lüheii, Oehlner.

Hitherto this species has only been found in the herring

* In Miss Lebour's figure of *Hemiurus communis* the sucker-ratio is, by measurement, exactly 2 : 3.

and sprat, but I have to record its occurrence on at least one occasion in the stomach of *Trigla gurnardus*. It is rarely absent from the herring, but is more seldom found in the sprat, being present in only about 10 per cent. In the latter fish it is not confined to the stomach, but may be found in the œsophagus, cæca, and even the intestine.

It is readily distinguished from *Hemiurus communis* by the comparatively enormous length of the pars prostatica, but this does not serve to separate it from *H. appendiculatus*. The specific features of *H. lühei* are:—length of soma 1·5–3·5 mm.; average breadth $\frac{1}{6}$ of length; ecsoma not more than $\frac{1}{2}$ length of soma, frequently much less; neck not more than $\frac{1}{6}$ of soma. The limits $\frac{1}{12}$ – $\frac{1}{10}$ for the neck given by Odhner are certainly much too small, although they serve to emphasize the fact that the suckers are more approximated in *H. lühei* than in *H. communis* and *H. appendiculatus*. The diameter of the ventral sucker is $\frac{1}{12}$ – $\frac{1}{10}$ of the length of the soma, and it is thus relatively much smaller than in the other two species. The sucker-ratio is 3 : 5 in such a large number of my specimens that I am inclined to regard that as fairly constant and more accurate than the ratio which Odhner gives, namely 2 : 3. In some of my specimens it certainly reaches 2 : 3, but in others it falls as low as 1 : 2. Both divergences are probably due to contraction of one or other sucker. The œsophagus is almost entirely absent. The genital sinus extends back as far as the anterior border of the ventral sucker; the vesicula seminalis is bipartite, the anterior part being muscular, the other not, and it is situated far behind the ventral sucker (about $\frac{1}{4}$ of the length of the soma). The testes lie immediately behind the vesicula, and as the ovary lies at about the same level as in *Hemiurus communis* it follows that the genital glands are closer together than in that species.

Distomum sp.

From the rectum of *Cyclopterus lumpus* a small immature Distome was obtained, the identity of which I have not been able to determine. It was elongated, more pointed posteriorly than in front, and measured about ·5 mm. The body was entirely covered with spines. The oral sucker was slightly larger than the ventral sucker; the latter situated rather behind the middle of the body. Long prepharynx; small pharynx; small round sac-like excretory vesicle*.

* A number of specimens of the same form, again immature, have recently been found by my friend Mr. William Small. The species apparently belongs to the genus *Lepidapedon* (*Lepodora*), but its identity with either of the already known species of that genus is not evident.

Gasterostomum triglae, van Beneden. (Pl. I. fig. 6.)

Numerous examples of this species were frequently obtained in the intestine of *Trigla gurnardus*. They measured 1-3.5 mm. in length. A few immature specimens were also present under 1 mm. in length. Whether they are really identical with the *Gasterostomum triglae* of van Beneden* is doubtful.

The shape is somewhat more elongated than is usual in the genus, so that the breadth is only $\frac{1}{6}$ - $\frac{1}{5}$ of the length. The whole surface of the body, quite to the posterior end, is covered with numerous spines. These are large and strong about the middle part of the body, but decrease in size towards each end and particularly towards the hinder end.

The anterior sucker is subterminal and comparatively large, having a diameter of .23 mm. in a specimen 3 mm. long, i. e. $\frac{1}{3}$ of the body-length. It has a thick rim, but a shallow cavity. The posterior sucker (pharynx) is small and insignificant, measuring only .12 mm., i. e. almost exactly half the anterior sucker. It is round and is situated just behind the middle point of the body.

The most characteristic feature of the species is entirely omitted in van Beneden's figure. This is a peculiar fan-shaped structure surmounting and overhanging the anterior sucker. The upper surface of the structure is thrown into five ridges, with depressions between, all radiating from a point corresponding to the centre of the sucker. These ridges project over the dorsal edge of the structure and appear as small symmetrically arranged papillæ. The two corners of the edge overhanging the sucker also appear to be raised as papillæ, but they are not so prominent. The structure is thus seven-pointed, five of the points being dorsal and two ventral, overhanging the sucker. In none of my specimens, either in the living state or preserved, were the papillæ much extended, and indeed in some of them they were so small as to be almost invisible. This latter fact may account for van Beneden's failing to observe them. These papillæ are evidently homologous with the much more exaggerated tentacle-like papillæ of *Gasterostomum fimbriatum*.

The alimentary system consists of a short simple sac opening from the posterior sucker and directed forwards.

The testes are two fairly large round or oval bodies, situated, one directly behind the other, on the right side of the body and not far behind the posterior sucker. The cirrus-pouch is

* Mém. Ac. Roy. Belg. xxxviii. pl. iii. fig. 15.

comparatively short, not extending further forward than the middle of the posterior testis. Its structure does not appear to differ from that in the other species of the genus.

The ovary is situated a little in front of the anterior testis and almost on a level with the posterior sucker or even slightly in front of it. It is about the same size as each testis and is round or somewhat oval. The yolk-glands consist of two separate lateral groups of follicles, extending from the posterior sucker halfway towards the anterior sucker or a little further forwards. The yolk-ducts run down on each side and unite just behind the posterior sucker. The uterus is very extensive, occupying the greater part of the body from a short distance behind the anterior sucker. The ova are extremely numerous and for the most part of a rich brownish-yellow colour; they are regularly ovoid and of surprisingly uniform size, measuring $\cdot 035\text{--}037 \times \cdot 021\text{--}\cdot 023$ mm.

The above description agrees to a certain extent with van Beneden's figure of *Gasterostomum triglae*. In his figure the yolk-glands are rather far forward, the genital glands are on the left side of the body, the anterior sucker is elongated, and the structure surmounting the sucker is not represented. The absence of this is sufficient to throw doubt on the identification of my specimens with *G. triglae*, van Ben., for the structure is usually so prominent in my specimens that it seems impossible that anyone could have missed seeing it. On the other hand, the similarity in internal anatomy and the fact that both come from the same host are suggestive of their identity. *Gasterostomum triglae*, van Ben., can hardly be considered a properly characterised species; all that van Beneden gives is a figure with not a word of description. It seems inadvisable, however, to create a new specific name for my specimens from *Trigla gurnardus*; further research will probably throw more light on their identity.

Gasterostomum gracilescens, Rud.

A large number of immature specimens of this species were found in the stomach of a cod. The latter is not regarded as a final host of this species, although it functions as an intermediate host for the encysted cercariæ. Adult *Gasterostoma* have never been found in it. The specimens under consideration had probably come from some Gadoid fish ingested by the cod, and it is doubtful if they would have attained maturity in this host.

EXPLANATION OF PLATE I.

The following letters apply to all the figures:—

<i>BS.</i> Ventral sucker.	<i>PG.</i> Genital aperture.
<i>CB.</i> Cirrus-pouch.	<i>PP.</i> Pars prostatica.
<i>DR.</i> Yolk-reservoir.	<i>T₁, T₂.</i> Testes.
<i>DSt.</i> Yolk-glands.	<i>RS.</i> Receptaculum seminis.
<i>Ex.</i> Excretory vesicle.	<i>Ut.</i> Uterus.
<i>J.</i> Intestinal diverticula.	<i>Vg.</i> Vagina.
<i>KSt.</i> Ovary.	<i>VS.</i> Vesicula seminalis.
<i>On.</i> Ova.	

- Fig. 1.* (*Lebouria*) *alacris*, Lss. Ventral view. $\times 50$.
Fig. 2. *Dihemistephanus lydie* (Stoss.). Ventral view. $\times 45$.
Fig. 3. Ditto. Head, dorsal aspect. $\times 105$.
Fig. 4. *Zoojonus rubellus* (Olsson). Ventral view. $\times 75$.
Fig. 5. *Lecithaster gibbosus* (Rud.). Ventral view. $\times 50$.
Fig. 6. *Gasterostomum trigræ*, v. Ben. Ventral view. $\times 30$. *AS.*, anterior sucker. *PS.*, posterior sucker.

II.—*Descriptions and Records of Bees.*—XXI. By T. D. A. COCKERELL, University of Colorado.

Agapostemon sulcatulus, sp. n.

♂.—Length 8 mm. or slightly over.

In Crawford's table (Pr. Nebraska Acad. Sci. 1901, p. 158) it runs to E, but does not resemble *A. nasutus* or *A. rhopalocera*; except for the small size it runs to C, and runs out because the head and thorax are brilliant green, not at all blue, and the yellow band on the clypeus is without any sign of a tooth or projection. Form slender; scape black, with a broad yellow stripe in front; flagellum dull ferruginous beneath, black above. Wings perceptibly dusky, with a yellow or orange tint; stigma dull amber-colour, nervures dark fuscous. Metathorax above shining and very coarsely wrinkled, the area not defined; posterior face with strong sharp edges; first four trochanters yellow with a little black, hind trochanters black. Legs yellow, a large black patch on apex of hind femora and a small spot on middle ones; middle and hind tibiæ with a black band on outer side and a dark apical spot, anterior tibiæ with a dark mark behind. Abdomen with five yellow dorsal bands, that on first segment narrowed in the middle; venter with fuscous markings,